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Algorithm for planetary limb/terminator extraction using Voronoi tessellation

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Abstract

This paper presents a novel semi-automatic image processing technique to estimate accurately and objectively the position of a planetary body on an image. The method is based on the detection of the limb/terminator using the VOronoi Image SEgmentation (VOISE) algorithm [1]. The result of the segmentation is then used to find the best fit to algebraic expressions for the limb/terminator of the planetoid.

Method and Illustration

The method consists of three phases: (i) detection of the limb/terminator of the planet disc using VOISE, (ii) selection of points from the VOISE map that surround the limb of the planet disc, and (iii) nonlinear fit of the selected set of data from VOISE to a disc model. Fig. 1 shows the detection of the limb using

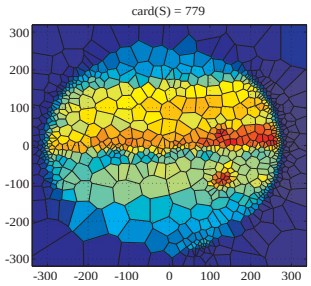

Figure 1: Detection of the limb.

VOISE on an image of Jupiter from the Infrared Telescope Facility, kindly provided by M. Lystrup. The parameters (see [1]) have been set to (i) division phase: $d_m^2 = 12$, $p_{\rm D} = 98\,\%$ (ii) merging phase: $p_{\rm M} = 50\,\%$, $\Delta\mu = 20\,\%$ and $\Delta\mathcal{H} = 30\,\%$ (iii) two iterations in the regularisation phase. Fig. 2 shows the selection of points from the segmentation. Seeds must lie within an

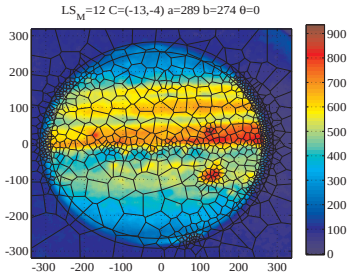

Figure 2: Selection of the seeds from the tessellation.

elliptic torus with specified parameters, and each region must have a scale height smaller than a threshold. Fig. 3 shows the result of fit to an ellipse parametrised

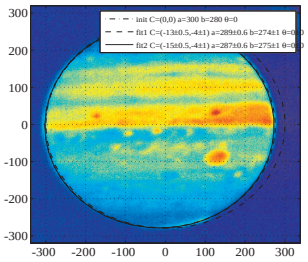

Figure 3: Fit to an ellipse for the selected points.

in polar coordinates. The ellipse is justified in the situation where the limb is nearly fully illuminated, as is the case here.

References

[1] Guio, P. and Achilleos, N.: The VOISE Algorithm: a Versatile Tool for Automatic Segmentation of Astronomical Images, Mon. Not. R. Astron. Soc., 398, pp. 1254-1262, 2009.